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WITNESS my hand this
Twenty-eighth day of November 2003

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AUSTRALIA

Patents Act 1990

Australian Arrow Pty Ltd

PROVISIONAL SPECIFICATION

Invention Title:

Passive Entry System

The invention is described in the following statement:

This invention relates to an entry system and in particular to a system that will allow entry to or facilitate access to a restricted area using an access communications protocol.

While the invention will be described with particular references to passive access to a motor vehicle, it will be appreciated that the invention may be adapted for use in relation to access or entry to any other form of restricted area, including buildings, rooms, containers of all types and the like.

It has been proposed to provide motor vehicles with a passive access system which allows an authorised person access to the vehicle. In one such proposed system, a user initiates an excess communications protocol by, for example, touching or lifting a door handle or even simply by approaching the vehicle. When the access communications protocol is initiated, a signal is transmitted by a base station in the vehicle. The authorised person will be carrying a transponder which responds to the transmitted signal with an identification code which is recognised and authenticated by the base station so that one or more vehicle doors are unlocked.

In many instances, however, more than one transponder may be in proximity to the vehicle, and each transponder may respond to the transmitted signal. Accordingly, a plurality of response signals is received by the base station which is unable to recognise an individual signal.

When a multiplicity of signals are transmitted substantially simultaneously, the signals can be linearly added together which results in an individual signal being sufficiently degraded as to prevent adequate decoding by the base station.

It has been proposed to use time slots for individual response signals to enable separation of individual signals. However, when a plurality of transponders are associated with a particular vehicle, such as for a business car pool or the like, long timing delays occur which are associated with the time slots allocated to each transponder associated with the vehicle.

Still further, transponders associated with other vehicles may also be caused to respond to an initiating base station signal. Such extraneous transponder responses may also result in the received data at the base station being composed of signals from more than one transponder, and so be corrupted.

It is therefore desirable to provide an improved system to facilitate access or entry to a restricted location.

It is also desirable to provide an improved passive access system which is able to respond to two or more transponder signals upon initiation of an access communications protocol.

It is also desirable to provide an improved passive access system which avoids delay in response time which may otherwise occur with time slot or other separation systems.

It is also desirable to provide an improved passive access system whereby any number of transponders may be programmed to be associated with one entry or access base station.

It is also desirable to provide an improved passive access or entry system, particularly for motor vehicles, which may be used in a variety of applications and with different forms of coding sequences, identifying signals and signal sequences.

In accordance with one aspect of the invention there is provided a passive access system to enable an authorised user access or entry to a restricted location comprising:

a base station;

initiation means to initiate an access communications protocol which includes causing the base station to transmit one or more actuating signals;

one or more transponder means each responsive to the actuating signal to transmit an individual coded response signal;

processor means to process the received response signals and to perform a Fourier transform to develop an identification of the individual received response signals; and

the base station selecting one of the identified response signals and authenticating the transponder responsible for the transmission of that selected response signal.

The initiation means, according to one embodiment of the invention, may include an electrical switch associated with a door handle such that relative movement of the door handle initiates the access communications protocol.

Preferably, the actuating signal transmitted by the base station is a low frequency signal having a field range of, for example, between 0.5 and 2.5m. When the invention is used in relation to a motor vehicle, any and all

transponders which are within the low frequency field will respond to that field for a predetermined period of time with a unique tone or dual tone multiple frequency (DTMF) signal or multiple tones. In this embodiment, the received signals are processed by an RF receiver and demodulator associated with the base station. The demodulated, composite signal is then processed by the base station signal processor which performs a Fast Fourier Transform (FFT) on the time domain signal.

The resulting spectrum computed by the FFT will be a number of tones representative of the number of transponders present in the LF field. On detection of these tones, the base station controller may then perform a check to determine which of the transponders has the highest priority. That transponder is then interrogated by the base station for authentication.

In another embodiment, after selecting one of the identified response signals, the base station is tuned to the unique identification signal of the selected transponder for authentication.

According to another aspect of the invention there is provided an access control system to enable an authorised person access or entry to a restricted area or location and comprising a base station adapted to transmit one or more actuating signals either at predetermined intervals or on the occurrence of a predefined event, one or more transponder means each responsive to the actuating signal to transmit an individual, coded response signal, processor means to process the received response signals and to perform a Fourier transform and/or spectial analysis to develop an identification of the individual received response signals, the base station selecting one of the identified response signals and authenticating the transponder responsible for the transmission of that selected response signal.

In order that the invention will be more readily understood, one embodiment thereof will now be described with reference to the accompanying drawings wherein:

Figure 1 illustrates the signal transmission of a single transponder;

Figure 2 shows the tone spectrum of the single transmission;

Figure 3 illustrates multiple transponder signals;

Figure 4 shows the linearly added signals received by the base station; and

Figure 5 shows the spectrum separation achieved by this embodiment of the invention.

Many motor vehicles have a number of keys, incorporating transponders, assigned to the vehicle. Generally, the keys are allocated individual serial numbers that separate them from other keys assigned to the same vehicle but which also links them to the given vehicle. Therefore, each key has a unique number both for itself and in relation to the assigned vehicle.

When keys are tied to a given vehicle the transponders are assigned a tone or DTMF code or multiple codes that will link them to a particular serial number that is unique to them and which is known to the base station located in the vehicle. When any one of the transponders assigned to a vehicle, or even transponders assigned to other vehicles, is within an LF field initiated by a base station, on actuation of a door handle switch or the like, all the transponders will respond for a given period of time by generating a signal with their own unique tone or DTMF signal or multiple tones.

For all signals transmitted to air, the atmosphere either in free space or in a vacuum represents an environment where signals can be linearly added together. In the case where there is more than one transponder in the LF field established by the base station, then the transmitted RF signals from each transponder are linearly added.

Normally, this would result in a signal received by the base station receiver being sufficiently degraded to not allow adequate decoding.

Referring to the drawings, as seen in Figure 1, when a single key and encoder 12 is present within the LF field initiated by a base station 14 (located within the vehicle 16) the transmitted signal 18 is received by an RF receiver associated with the base station 14. Only the base band signal 18 has been represented. The transmitted data from the key is seen in Figure 2 as a single spectral component 19 by the vehicle signal processing controller of the base station 14.

On this basis, the time domain signal 18 transmitted by the transponder is that rece ived by the base station 14. In this instance, with a single signal transmission, there is no degradation experienced in the signal received at the base station.

Referring to Figure 3, in the situation where more than one key/transponder is present in the LF field, the individual response signals 21, 22, 23 and 24 transmitted by the four key/transponders 26, 27, 28 and 29, respectively are linearly added together when received by the RF receiver of

the base station 14. The individual transmitted signals 21-24, as shown in Figure 3, are all distinct signals having their own individual identity. When summed together the resulting received signal is a composite of the transmitted signals as shown in Figure 4. Ordinarily, the received signal of Figure 4 could not be decoded and, hence, with all the transponder signals 21-24 colliding with each other, the base station is prevented from recognising and authenticating any one of the four transponders.

In accordance with this embodiment of the invention, the signal processor of the base station performs a Fast Fourier Transform to the received signal shown in Figure 4. The result of the FFT is the transformed signal 31 shown in Figure 5 and which separates the four spectral components into the four separate signals to allow further signal processing to be performed on the received signal. By this means, the identity of the individual transponders 26-29 may be ascertained. The base station is then able to select one of those transponders to establish authentication and provide access to the vehicle. In the authentication process, a unique code to which only the selected transponder will respond is transmitted by the base station and the coded response is used for access authorisation.

When transponders are initially associated with, assigned to or programmed to a vehicle each of then is assigned a unique identity number, which may be associated with a vehicle manufacturer, a key number and a unique tone for the individual vehicle. Each vehicle may have a number of keys/transponders, all the identities of which will be pre-programmed into the vehicle base station, and all of which will be distinct. Thus, key number one for a particular vehicle may have tone number one, key number two has tone two, and so on. On initiation of the passive entry or passive access system, by actuation of a door handle switch, boot lid switch or other known form of passive actuation initiation, the base station will transmit a command via the LF field to which all the transponders will respond if they are within range of the LF field. The base station 14, on receipt of the identifying transponder tones, and after performing a FFT on the received signal to separate the individual tones of each transponder, will select one of the transponders using the key number identifier, and only this key/transponder will respond to the authentication process commands transmitted by the base station. The selection process for a particular key to respond may be

arbitrary, or may be coded to key/transponders in a predetermined hierarchal order.

It will be appreciated that the system of the invention is able to be used to separate received signals transmitted by transponders unassociated with the vehicle in question. Thus, if a transponder from another vehicle is within range and is actuated by the initiating signal, the invention will be able to distinguish any such transmitted signal from others received by the base station receiver.

Although the invention has been described using a Fourier transfer and/or spectial analysis, it will be understood that other forms of numerical analysis may be used in the performance of the invention.

Many modifications may be made in the design, construction and operation of a passive access system in accordance with the present invention. Such modifications may include adapting the system for use in providing access or entry to a building, container or other restricted area or location.

Still further, the system of the invention may also be used in relation to other forms of access or entry control systems which involve the initiation of or continuous transmission of a transponder awakening signal. Thus, the system of the invention may be adapted for use with a vehicle, building or other restricted area control system wherein a continuous transponder initiation signal is transmitted, at low frequency and low range, without the necessity to have a user actuate an initiation switch or the like.

All such modifications which come within the scope of the invention shall be deemed to be within the ambit of the above description.

Dated this 19th day of November 2002

Australian Arrow Pty Ltd
Patent Attorneys for the Applicant:

F B RICE & CO

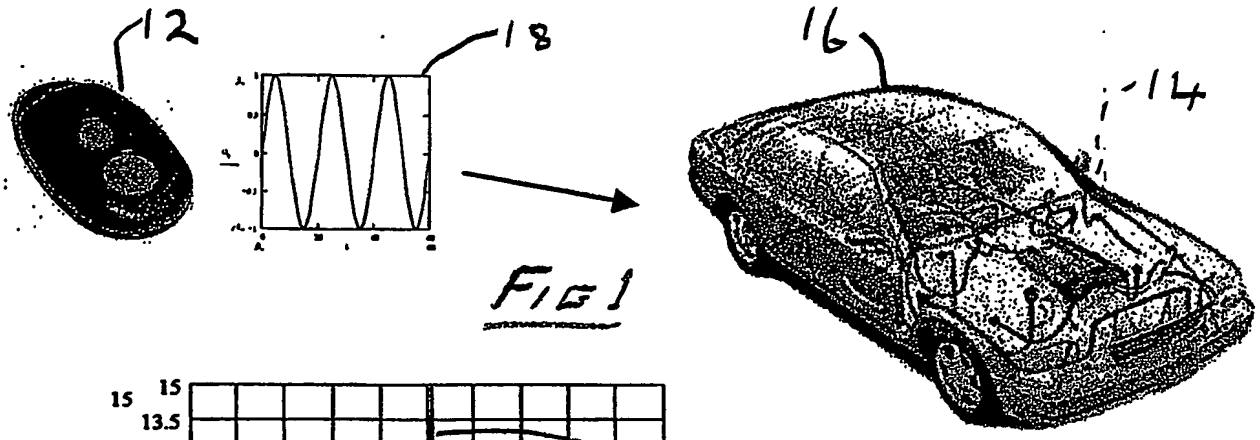


FIG 1

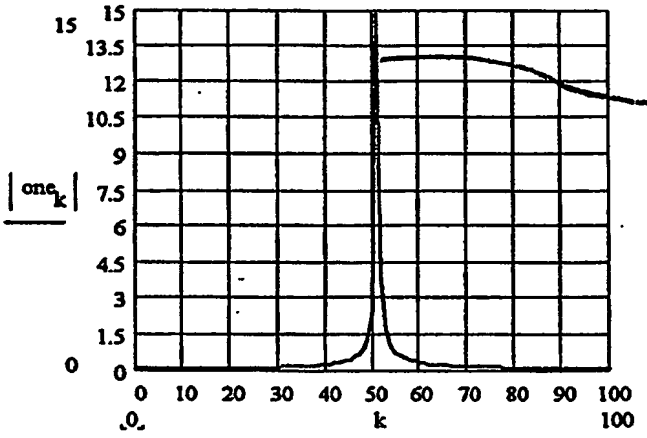


FIG 2

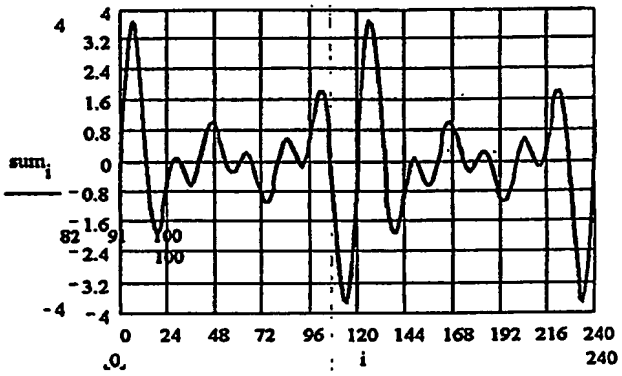


FIG 4

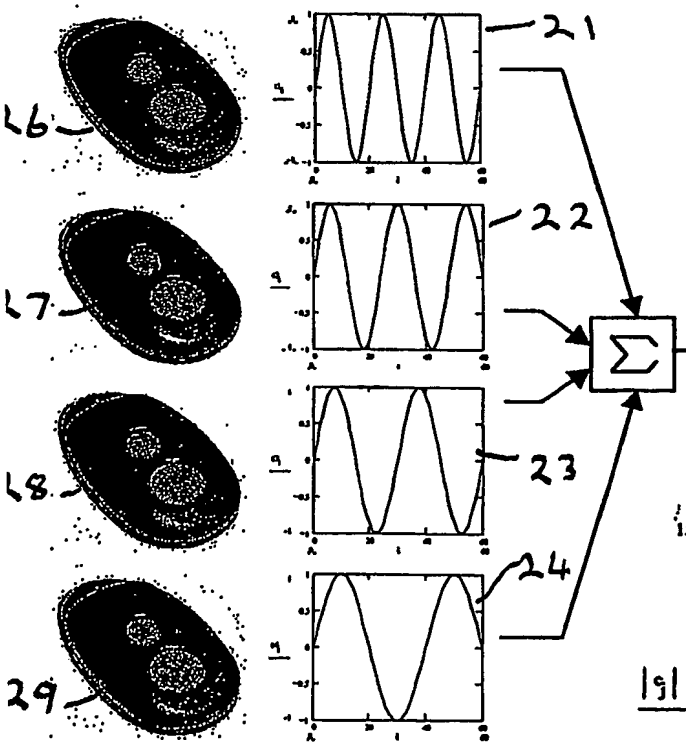
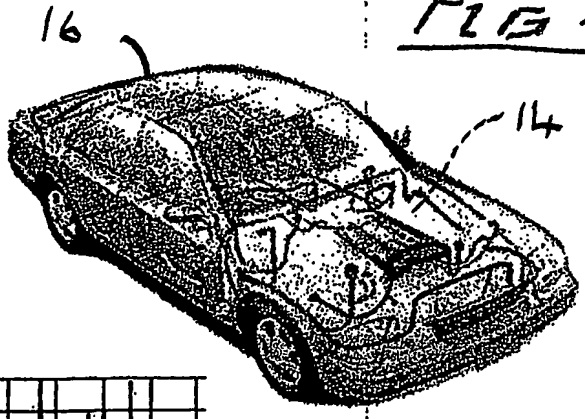


FIG 3



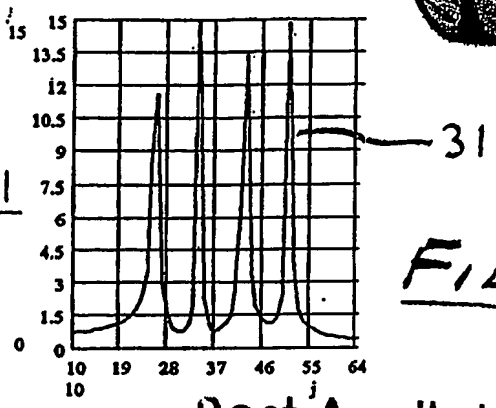


FIG 5